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KLEMENS SENSEN et al

EXTRUDER DIE HEAD

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an extruder die head, preferably a blown film head, comprising a central annular channel, which is provided with an annular outlet die and into whose outer limiting wall empty annular slits, which feed a polymer melt and which constitute the smaller diameter openings of truncated channels, formed between the internal and external shells of stacked, conical insert members.

Related Art

[0002] EP 0 568 544 B1 discloses an extruder head for extruding multi-layered thermoplastic pipes of the kind described above, whose central annular channel is defined by a central mandrel, whose shell forms the inside wall of the channel, and by stacked conical insert members, which enclose the channel and whose inside openings form the outer wall of the central annular channel. In this prior art extruder head, a truncated channel is formed between two bell shaped or conical insert members, which are provided with a radial feed borehole for the polymer melt. For each tubular layer of polymer melt to be extruded there are two conical insert members, which are stacked one over the other. The space between these insert members forms the annular slits. The insert members are held together by these clamping cover parts, which are connected together with

tightening screws. The prior art extruder die head exhibits a significant overall length, when multilayered pipes are to be produced. However, such long extruder die heads exhibit the drawback that the large height of the extruder die head results in long flow paths for the polymer melt. These paths in turn result in high rheological stress at the melt interfaces, a state that can lead to unstable flow behaviour. In particular, the long flow paths are a problem with polymer melts that cannot tolerate heating for a prolonged period of time. Such polymer melts decompose and become brittle when heated for long periods.

SUMMARY OF THE INVENTION

[0003] Therefore, the object of the invention is to provide an extruder die head of the class described in the introductory part. This extruder die head facilitates the extrusion of plastic tubes with arbitrary layers, but is characterized by a significantly shorter construction height.

[0004] The invention solves this problem in that the annular slits, feeding the polymer melts, also empty into the inside wall of the central annular channel. The annular slits are the smaller diameter openings of truncated channels, formed between the internal and external shells of stacked conical internal insert members.

[0005] It is also easy to build the extruder die head of the invention in modules. A number of conical insert members are stacked until the desired number of layers of the extruded tube is reached. While maintaining the same number of conical feed channels, thus the same number of extruded tubular layers, it is possible to make the extruder die head of the invention half the construction length of the prior art extruder die head, because, based on the length of the conical insert members, two annular

slits that feed the polymer melt can empty into the central annular channel. The significantly reduced axial length of the extruder die head of the invention results in an improved flow pattern of the melt that is fed in and less heat stress on the melt, because the melt spends correspondingly less time in the extruder die head.

[0006] The overall length of the extruder die head of the invention can be further reduced in that the internal and external shells of each insert member define the truncated channels for feeding the polymer melts into the central annular channel. In contrast to the prior art extruder die head, this design reduces the size of the conical insert members to half of their former size so that the overall length is correspondingly shortened.

[0007] The internal and external annular slits, which empty into the central annular channel, can lie in the same radial planes. Of course, it would also be possible to move the annular slits axially.

[0008] Preferably the internal and external shells of the conical insert members are two counter rotating spiral channels, whose depth tapers off in the direction of the opening. This design of the channels, wherein the melt overflows the channels in the axial direction, is well known.

[0009] These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

DESCRIPTION OF THE DRAWINGS

[0010] The invention is explained in detail with reference to the following drawings.

[0011] Figure 1 is a cross sectional view of a blown film die head with annular or conical channels, feeding five different melts.

[0012] Figure 2 is a sectional view of a blown film die head with annular or conical channels, feeding nine different melts.

DESCRIPTION OF THE INVENTION

[0013] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

[0014] Figure 1 is a schematic drawing of a sectional view of a blown film die head, where five annular or conical channels, which feed different types of polymer melts, empty into a central annular channel 1.

~~**[0015]** The blown film die head comprises a bottom annular~~ cover 2, which serves to hold conical insert members that are stacked on the cover 2, and a top holding ring 17, 18. Each conical insert member includes an inside ring 4, 8, 9 and a corresponding outside ring 5, 10, 11. Bottom inside ring 4 has a cylindrical outer wall 44 and a conical inner wall 45. Both walls 44, 45 have a spiral groove 6, 66 whose depth tapers progressively toward the top of the groove. Bottom outside ring

5 has a cylindrical inner wall 54 and a conical outer wall 55. Only conical outer wall 55 has a spiral groove 56. A first cylindrical feed channel 3 is formed between the rings 4 and 5, which exhibit a triangular cross section. The ring base faces are screwed or clamped together with the bottom cover 2 in a manner that is not illustrated here. The bottom cylindrical outer wall 44 and the cylindrical inner wall 54 define the cylindrical feed channel 3 and the spiral groove 6, whose depth tapers off toward the top becomes slotted helical passages which are indicated by the three grooves 6. Channels 7, feeding a first polymer melt, empty into the bottom of helical passage 6.

[0016] Stacked on the bottom rings 4, 5, which lie in a common plane, are inner middle conical ring 8 and outer middle conical ring 10. The middle conical rings 8, 10 define conical areas with the bottom rings 4, 5 and spiral passages 56, 66 connected to internal truncated conical annular channels 12, 13. The conical areas are formed by a conical middle inner wall 84 with the bottom conical inner wall 45, and a conical middle outer wall 105 with the bottom conical outer wall 55. These conical melt feed channels 12, 13 empty into a central annular channel 1, which is a continuation of the cylindrical feed channel 3 formed between the inside and outside cylindrical shell areas, generally indicated by 108, of the middle rings 8, 10. The conical external shells of the rings 4, 5 have in turn spiral grooves 56, 66, whereby the melt feed channels (not illustrated here) empty into the bottom grooves having the greatest depth.

[0017] Mounted on the middle conical rings 8, 10 are top conical inner ring 9 and top conical outer ring 11, which define with the conical external shell areas. The conical areas are formed by a conical middle inner wall 89 with a conical top inner wall 98, and a conical middle outer wall 111 with a top conical

~~outer wall 110. Conical melt feed channels 130, 120 empty into~~ the central annular channel 1. The external shell areas of the middle rings 8, 10 have spiral grooves, whose height tapers off toward the top, on the inner middle conical wall 89 which meets with the outer middle conical wall 111.

[0018] The internal truncated conical annular channels 13, 130 and the external truncated conical annular channels 12, 120 slope in opposite directions at approximately the same angle to the central annular channel 1. The internal truncated conical annular channels 13, 130 communicate with the central annular channel 1 in approximately the same radial plane. Also, the external truncated conical annular channels 12, 120 similarly communicate with the central annular channel 1. The internal 13, 130 and external 12, 120 truncated conical channels are substantially concentrically spaced around the central annular channel 1. The bottom grooves with the greatest depth are fed by the melt feeding channels 15, 16.

[0019] Mounted on the top conical rings 9, 11 are top inside and outside holding rings 17, 18, between which the central annular channel 1 is defined with an annular outlet slit 19. An easy method for assembling the blown film die head together with the bottom cover 2 is to connect the top holding ~~rings 17, 18 with tightening screws.~~

[0020] The inside rings 4, 8, 9 and the bottom cover 2 exhibit aligned axial passages, which form a passage channel 140 which houses the lines to feed in and exhaust the blowing air for the blown film die head.

[0021] The blown film die head, shown in Figure 2, exhibits in principle the same construction, as described with reference to Figure 1. The distinction between it and the blown film die head, depicted in Figure 1, lies only in the fact that

between the inside and outside middle conical rings 8, 10 and the top inside and outside rings 9, 11 there are additional inside conical rings 21, 22 and additional outside conical rings 23, 24, which are designed analogously to the middle rings 8, 10. This arrangement of the additional conical rings makes it possible to feed, not five melts, but nine different melts with the blown film die head of Figure 2 for the purpose of producing a nine layered plastic tube.

[0022] The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and, accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.